

CLAIMS:

1. A radio transmitter, comprising:

a digital processor digitally modulates digital data to produce a digitized baseband signal,
5 that converts the digitized baseband signal to a digitized Intermediate Frequency (IF) signal,
and that outputs the digitized IF signal;

a digital-to-analog converter (DAC) coupled to receive the digitized IF signal wherein the
DAC converts the digitized IF signal to a continuous waveform IF signal;

10 a filter that receives and filters the continuous waveform IF signal and produces a filtered IF
signal; and

a translational loop that receives the filtered IF signal and that converts the filtered IF signal
15 to an Radio Frequency (RF) transmit signal.

2. The radio transmitter of claim 1 wherein the translational loop comprises:

a phase-frequency detector (PFD) coupled to receive the filtered IF signal as a reference
20 signal and coupled to receive a feedback signal that is based upon the RF transmit signal,
wherein the PFD produces a control signal reflecting a phase difference between the filtered
IF signal and the feedback signal;

a charge pump for producing an error current signal based upon and proportional to the
25 control signal;

a loop filter for converting the error current signal to an error voltage signal; and

an oscillator coupled to receive the error voltage signal, the oscillator for producing the RF
30 transmit signal corresponding to a magnitude of the error voltage signal.

3. The radio transmitter of claim 2 further including a divide by N module coupled to receive the oscillation and for dividing the oscillation by N.

4. The radio transmitter of claim 3 further including mixer and filter circuitry for down
5 converting and filtering the oscillation to produce the feedback signal.

5. The radio transmitter of claim 1 wherein the desired frequency of operation of the filtered continuous waveform IF signal is equal to 26 MHz.

10 6. The radio transmitter of claim 5 having a sample rate that is a multiple of 26 MHz.

7. The radio transmitter of claim 6 wherein the multiple is greater than 2.

8. The radio transmitter of claim 7 wherein the sample rate of the digital processor is
15 equal to 104 MHz.

9. The radio transmitter of claim 7 wherein the sample rate of the digital processor generates harmonic tones that are located outside of at least one specified frequency band of interest.

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10. The radio transmitter of claim 9 wherein the radio transmitter operates according to a global system for mobile communications (GSM) protocol and wherein the sample rate of the digital processor is equal to 338 MHz.

11. A method for producing a continuous wave intermediate frequency (IF) signal, comprising:

producing digital data at a sample rate that is a specified multiple of a desired frequency of
5 operation;

digital signal sampling the digital data at a rate corresponding to the sample rate to produce a zeroth order filtered continuous waveform signal; and

10 filtering and smoothing the zeroth order filtered continuous waveform signal to produce a continuous wave intermediate frequency (IF) signal.

12. The method of claim 11 wherein the continuous wave intermediate frequency (IF) signal is produced to a phase-frequency detector (PFD) as a reference signal.

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13. The method of claim 11 further including adjusting a phase modulation index by one half to compensate for a divide by 2 module in a feedback loop that produces a feedback signal to the PFD for comparison with the reference signal based on a selected output transmission frequency.

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14. The method of claim 11 wherein the sample rate of the digital data is 104 MHz.

15. The method of claim 11 wherein continuous waveform signal has a frequency of 26 MHz.

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16. The method of claim 15 wherein the sample rate of the digital data is 338 MHz.

17. The method of claim 11 further including determining whether to adjust a phase modulation index by $\frac{1}{2}$.

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18. The method of claim 17 wherein the determining whether to adjust a phase modulation index by $\frac{1}{2}$ further includes determining whether an output oscillation was divided by two prior to being propagated by a power amplifier.

- 5 19. The method of claim 18 further including down converting a divided oscillation signal to a frequency of interest to produce a feedback signal to a phase-frequency detector.

20. A global system for mobile communications (GSM) radio transmitter, comprising

digital processor for producing digital data at a 338 MHz sample rate;

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a high sample rate digital-to-analog converter (DAC) coupled to receive the digital data wherein the DAC samples the 338 MHz sample rate and produces a continuous waveform IF signal;

10 a filter for producing a filtered continuous waveform IF signal based upon the continuous waveform IF signal wherein the filtered continuous waveform IF signal oscillates at an IF frequency; and

15 a translational loop for producing an oscillation to a power amplifier for amplifying the oscillation prior to propagation and for producing a feedback signal based upon the oscillation to a phase-frequency detector (PFD) of the translational loop, wherein the PFD compares the continuous waveform IF signal to the feedback signal as a part of producing the oscillation.

20 21. The radio transmitter of claim 20 wherein the IF frequency is equal to 26 MHz.

22. The radio transmitter of claim 21 wherein the sample rate of the digital processor and the sample rate of the DAC generate harmonic tones that are located outside of at least one specified frequency band of interest.

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23. The radio transmitter of claim 21 wherein a phase modulation index of the digital data is adjusted by $\frac{1}{2}$ according to whether the output oscillation and phase modulation index produced by the translational loop are divided by two prior to being amplified and propagated.

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24. The radio transmitter of claim 21 wherein the phase modulation index of the digital data is adjusted whenever the output oscillation is not divided by two prior to being amplified and propagated.

5 25. The radio transmitter of claim 24 wherein the output oscillation is amplified and propagated as an 1800 MHz carrier signal.

26. The radio transmitter of claim 25 wherein the output oscillation is amplified and propagated as an 1900 MHz carrier signal.

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27. The radio transmitter of claim 25 wherein the phase modulation index of the digital data is not adjusted whenever the output oscillation is divided by two prior to being amplified and propagated.

15 28. The radio transmitter of claim 27 wherein the output oscillation is amplified and propagated as a 900 MHz carrier signal.

29. The radio transmitter of claim 27 wherein the output oscillation is amplified and propagated as a 950 MHz carrier signal.

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30. A digital processor for producing intermediate frequency digital data, comprising:

a baseband band data generator for producing digital data;

5 a first digital filter for interpolating the digital data to increase a sample rate of the digital data by a first factor value, the digital filter producing first upsampled digital data;

a Gaussian filter for producing Gaussian filtered digital data from the upsampled digital data;

10 a phase modulation index adjustment block for selectably adjusting a phase modulation index of the Gaussian filtered digital data;

an integration module for integrating the Gaussian filtered digital data;

15 a coordination rotation digital computer (CORDIC) module for generating I and Q vector rotated data components from the Gaussian filtered digital data;

a second digital filter for interpolating the I and Q vector rotated data components to increase a sample rate of the I and Q vector rotated data components by a second factor value, the

20 digital filter producing upsampled I and Q data components;

a multiplication module for multiplying the upsampled I and Q data components with modulation data to produce quadrature I and Q data; and

25 a summing node for combining the quadrature I and Q data to produce intermediate frequency digital data.

31. The digital processor of claim 30 wherein the first factor value is equal to twelve.

30 32. The digital processor of claim 31 wherein the second factor value is equal to thirty two.

33. The digital processor of claim 32 wherein the baseband digital data is produced at an approximate sample rate of 270.833 kHz.

5 34. The digital processor of claim 30 wherein a product of the first and second factor value is equal to 338.

35. The digital processor of claim 30 wherein a product of the first and second factor value is equal to 1248.

10 36. The digital processor of claim 30 wherein an output sample rate of the digital data is equal to 104 MHz.

37. The digital processor of claim 30 wherein an output sample rate of the digital data is
15 equal to 338 MHz